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COMPUTATIONAL MULTISCALE METHODS FOR TISSUE BIOMECHANICS

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ABSTRACT

In the field of biomechanics and life sciences, tissue modelling and simulation can be surely considered as a frontier and challenging task. Both mineralized (e.g., bone, tooth enamel and dentin, cartilage) and soft tissues (e.g., skin, muscles, tendons, ligaments, blood vessels) exhibit a precise structured and hierarchical arrangement, characterized by organized biostructures with different length scales (from nano up to the macroscale) [1,2]. This is the case of collagen fibrils and fibers in soft connective tissues, of actin and myosin myofibrils in muscle's sarcomere, of collagen lamellae in bone's osteon. Tissue mechanics and physiological functions are highly affected by such a hierarchical and multiscale organization, as well as by a number of coupled biochemical and mechanobiological processes. Moreover, tissue disorders and diseases can be generally related with histological and biochemical alterations at different scales (e.g., [3-5]).

The key goal of *in-silico* approaches in the field of tissue biomechanics is to develop computational methods and models that are able to integrate structural properties of the tissue and its physiological functions. In this way, reliable, predictive and patient-specific biomechanical analyses could be oriented for diagnosis and therapy optimization.

In this context, there is a great need for the development of accurate tissue constitutive models accounting for highly nonlinear and time-depending effects, governed by different physics and involving mechanisms at different length scales. To this aim, multiscale and multiphysics methods are giving to-date the most promising results (e.g., [6-12]). Accordingly, advanced single-scale and single-physics models of typical tissue substructures, inter-scale and inter-physics consistent relationships supported by experimental evidences, homogenization approaches, refined numerical methods and applications, can contribute towards the definition of accurate predictive theories and advanced computational formulations for tissue biomechanics.

The Minisymposium aims to bring together front-line researchers in the field of Computational Methods in Tissue Biomechanics, proposing multidisciplinary, original and

groundbreaking findings and contributions. The participants (about 15-20 invited contributions from Europe, USA and Asia) will also discuss recent developments and future directions. Participation is also open to researchers presenting experimental studies focused on, but not limited to, the validation of computational multiscale techniques in tissue biomechanics.

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